EDFAM

Erbium Doped Fibre Amplifier Module

Product User Manual

Offices:

China, Beijing : tel. +86-10-5791-0655
Americas, Florida : tel. +1-703-579-6777
AsiaPac, Melbourne : tel. +61-3-9780-5100
Australia, Melbourne : tel. +61-3-9780-5100
EMEA, Netherlands : tel. +31-36-536-8011

info@pbnglobal.com

www.pbnglobal.com

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Product User Manual

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1 Precautions

WARNING!

This equipment is intended for indoor applications. To prevent fire or electrical shock, or damage to the equipment, do not expose units to water or moisture.

- Ensure adequate cooling and ventilation as specified.
- The installation and operation manual should be read and understood before units are put into use.
- Always replace protective caps on optical connectors when not in use.
- The typical connectors fitted are SC/APC 8°. Note: 8° angle polished connectors must be used.
- Do not operate unit without all covers and panels properly installed.

Cleaning

Use only a damp cloth for cleaning front panel. Use a soft dry cloth to clean top of unit. Do not use spray cleaner of any kind.

Overloading

Overloading wall outlets and extension cords can result in a risk of fire or electric shock. Use approved electrical cords.

Damage requiring service

Unplug unit and refer servicing to Pacific Broadband Networks qualified service personnel only.

Servicing

Do not attempt to service this unit yourself. Refer all servicing to Pacific Broadband Networks qualified service personnel only.

WARNING!

Exposure to class 1M laser radiation is possible. Access should be restricted to trained personnel only. Do not view exposed fibre or connector ends when handling optical equipment.

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2 Introduction

2.1 Overview

The Erbium Doped Fibre Amplifier Module (EDFAM) has been designed for MATV, CATV, FTTH and CCTV broadband applications. This module utilises plug-and-play technology to provide a complete broadband and optical communications solution.

The output power available is from 20 mW to 250 mW (13 dBm to 24 dBm). Up to 80 mW a single pump laser is used. The larger EDFAM units employ dual pump lasers in a two-stage design with inter-stage isolators.

The EDFAM is designed to extend a 1550 nm CATV system fibre without need to convert back to RF. Combined with our LTE152 externally modulated laser transmitters, system ranges of up to 100 km are possible.

The larger power EDFAM units find application in Fibre-To-The-Home (FTTH) systems, permitting many thousands of subscriber nodes to be supplied with signal from a single laser source.

2.2 Features

- Plug and play OCM module.
- Erbium Doped Fibre Amplifier Module (EDFAM) extends analogue and digital CATV to suit long distance feeders or larger FTTH distribution systems.
- Single or dual 980 nm pump amplifier models are available with 20, 40, 50, 80, 100, 160, 200, 250 mW optical outputs.
- Suits 1550 nm dense wavelength division multiplexing (DWDM) applications.
- Designed for CATV broadband or digital data applications.
- Computer controlled status monitoring.
- Low noise performance.

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2.3 Models and Options

Model code:

EDFAM-[X]-[Y]-[Z] Optical amplifier module

Options:

X-Y Output Power:

20-1	20 mW (13 dBm)
40-1	40 mW (16 dBm)
50-1	50 mW (17 dBm)
80-2	80 mW (19 dBm), 2 optical outputs, each 16 dBm
100-2	100 mW (20 dBm), 2 optical outputs, each 17 dBm
160-2	160 mW (22 dBm), 2 optical outputs, each 19 dBm
160-4	160 mW (22 dBm), 4 optical outputs, each 16 dBm
200-4	200 mW (23 dBm), 4 optical outputs, each 17 dBm
200-5	200 mW (23 dBm), 5 optical outputs, each 16 dBm
250-6	250 mW (24 dBm), 6 optical outputs, each 16 dBm
250-3	250 mW (24 dBm), 3 optical outputs, each 19 dBm
250-4	250 mW (24 dBm), 4 optical outputs, each 18 dBm
250-8	250 mW (24 dBm), 8 optical outputs, each 30 mW (15 dBm)

Z Optical Connectors:

SC	SC/APC optical connectors
E	E2000/APC optical connectors
FC	FC/APC optical connectors

Examples:

EDFAM-160-4-SC

Optical amplifier module 160 mW, four outputs of 40 mW each, SC/APC.

EDFAM-200-5-SC

Optical amplifier module 200 mW, five outputs of 40 mW each, SC/APC.

EDFAM-250-8-SC

Optical amplifier module 250 mW, eight outputs of 30 mW each, SC/APC.

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3 Installation

3.1 Equipment Inventory

On receiving your new EDFAM, you should carefully unpack and examine the contents for loss or damage that may have occurred during shipping. Refer to warranty registration if loss or damage has occurred. The EDFAM pack will consist of the following:

Qty	Description
1	EDFAM, Erbium Doped Fibre Amplifier Module
1	EDFAM plug-and-play paddle board
1	Product User Manual (includes individual test sheet)
1	Warranty registration certificate

3.2 Packaging and Transportation

Keep all packing boxes and packaging of the EDFAM for future transport.

Use only the original packaging of the EDFAM when transporting. This packaging has been specifically designed to protect the equipment.

3.3 Power and Cooling Requirements

The EDFAM is powered by the power supply module of the OCM system, it consumes up to 22 W.

The EDFAM optical amplifier module and its corresponding OCM chassis should be located in an environment not exceeding a temperature range from 0...45 ºC with the OCM fans running. If the internal module temperature (parameter P06) exceeds 70 ºC, the module will activate an urgent alarm through the system.

Should the temperature exceed the above limits then the OCM should be relocated in the equipment rack where the ambient temperature will be less than 45 ºC.

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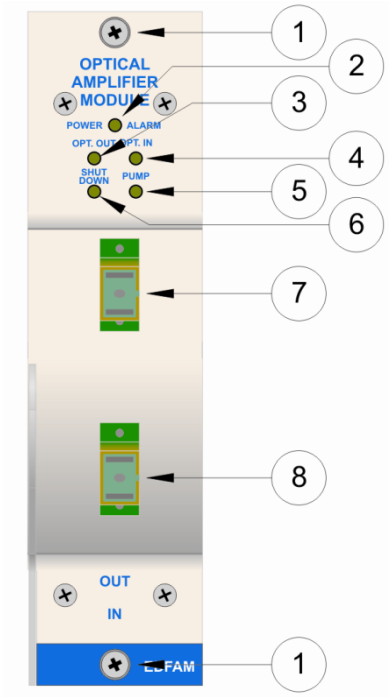
3.4 Front Panel Layout



Item	Description		
1	SCREWS	Front panel screws to fix EDFAM to OCM.	
2	POWER/ALARM	Green	DC power OK and No Alarms.
		Amber	Non-urgent alarm
		Red	Urgent alarm, see **Section 4.5**.
3	OPT. OUT	Green	Optical output level is OK.
		Red	Optical output is < 3 dB from rated power.
4	OPT. IN	Green	Optical input level is OK.
		Red	Optical input is too low, < -6.5 dBm.
5	PUMP	Green	Pump lasers operating OK.
		Red	Pump laser alarm.
6	SHUT DOWN	Green	Laser shut down not activated.
		Red	Laser shut down activated.
7	OPT. OUT	Optical output port, 8° angle polished SC, FC or E2000. Single port or dual port as ordered.	
8	OPT. IN	Optical input port, 8° angle polished, SC, FC or E2000	

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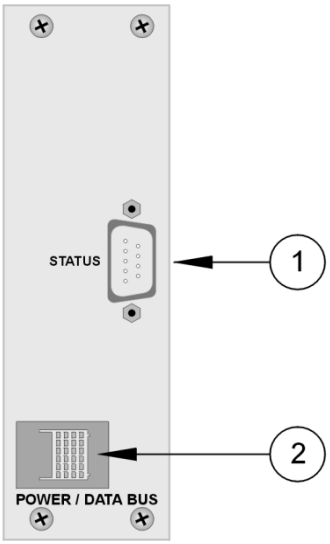
3.5 Rear Panel Layout



Item	Description	
1	STATUS	DB9-F status connector. Refer to **Section 3.6**.
2	POWER/DATA BUS	DC power input and bi-directional communication port.

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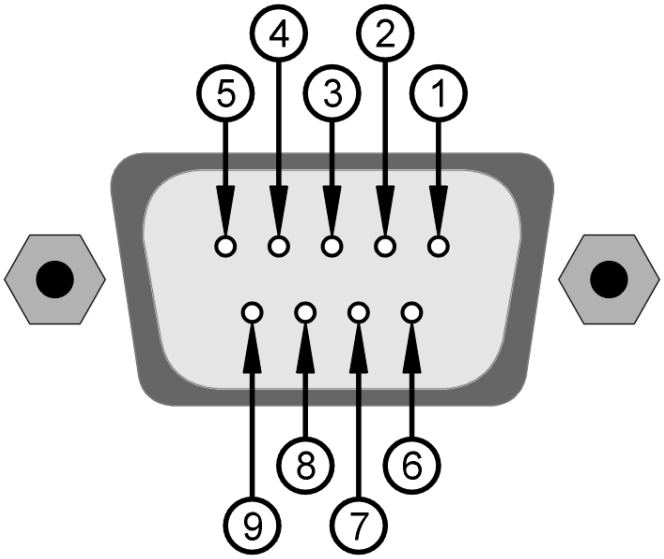
3.6 DB9-F Status Connector



Pin	Description
1	Digital 1 - normal operation
	Digital 0 - alarm condition
2	Not Used
3	Signal Ground
4	Not Used
5	Digital 0 - normal operation
	Digital 1 - alarm condition
6 - 9	Not used
SHIELD	Signal Ground

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3.7 Module Installation and Adjustment

1. Install the plug and play paddle board in the rear of the OCM chassis on the slot that will be used for the EDFAM. Fix the paddle board to the chassis with the screw provided.

> **Note:**
>
> The plug and play paddle board allows the EDFAM unit to be swapped with another, without the need to disconnect cables from the rear, as all cables are attached to the paddle board.

2. Hold the module upright and aligned to the OCM slide rails and carefully insert into the chassis. No excessive force should be used.

> **Tip:**
>
> When inserting the module into the guide rails, vertically twist the module slightly to check that the guides are properly seated on the rails.

3. Screw in the two front panel screws to secure the module to the chassis.
4. Connect the optical signal to the input of the EDFAM.
5. Verify, via the OCM user interface, that the module is recognised as part of the OCM system.

> **Note:**
>
> The module can be plugged in or out of the OCM chassis while power is being supplied to the OCM.

When powered, the LED indicators on front panel will light green or red. Refer to **Section 4.5** and **Section 5.5** for a description of the alarm indicators.

Due to Laser Safety precautions, the EDFAM is shipped with the output power switched OFF, (i.e. SHUT DOWN).

The user will have to activate the EDFAM via CONTROL1, refer to **Section 5.4.2**.

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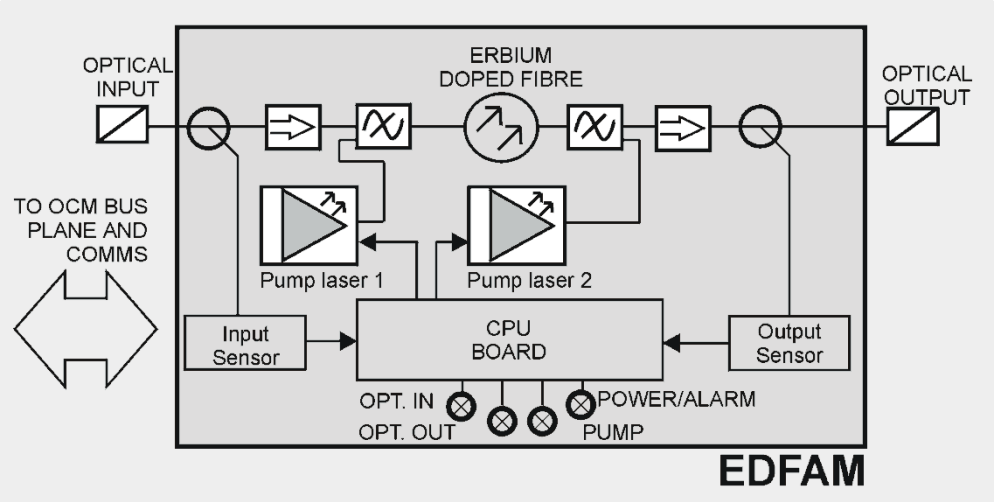
4 Technical Description

4.1 Overview

The EDFAM comprises an Optical Gain Block, Control Board and an OCM Interface block.



The Optical Gain Block consists of an Erbium Doped Fibre in conjunction with single or dual 980 nm pump lasers for high optical power efficiency.

The Control Board monitors and controls the Optical Gain Block and feeds the front panel LED indicators as described in **Section 3.5**.

The OCM Interface block performs module identification and system integration for NMS3 (network management).

4.2 Optical Gain Block

The Optical Gain Block has an input optical signal range of 0…6 dBm for which the output will be stable at its nominated optical power. Although the pump lasers will operate with input optical signals down to –5 dBm, optimum specifications will be met above 0 dBm.

The optical gain will be determined by the required optical output power minus the optical input power. The higher the gain the higher the noise figure (typically <= 5.0 dB).

The Optical Gain Block is driven by the Control Board which also performs the shutdown function of the lasers.

The optical connectors available are SC/APC, E2000/APC and FC/APC.

4.3 Control Board

The Control Board is designed to drive, monitor and control the Optical Gain Block. This also controls the LED indicators located on the front panel of the EDFAM. The Control Board in conjunction with the OCM Interface block gives the user full monitoring and control capabilities via the OCM control module or remotely using network management (NMS3).

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4.4 OCM System Integration

The OCM Interface block performs the OCM system integration. Each module is uniquely identified within the OCM chassis and the module parameters are monitored as described in **Section 5**. The interface block also allows the user to control the shutdown feature of the EDFAM via the OCM.

4.5 Alarm System

The EDFAM alarm system is designed to generate only urgent alarms. This is due to the importance of the EDFAM, as this module will usually drive a large portion of the optical distribution network. The urgent alarms are triggered as follows.

Urgent Alarms:

ALARM LED RED:	Internal temperature is > 70℃, or Pump lasers not operating, or Optical input is too low (< -6.5 dBm), or Optical output is too low (i.e. 3 dB less than rated output power).
OPT. IN RED:	Optical input is too low, i.e. < -6.5 dBm
OPT. OUT LED RED:	Optical output is too low, i.e. 3 dB less than rated output power.
PUMP LED RED:	Pump lasers failed
SHUT DOWN LED RED:	Shut down has been activated. There is no optical signal through the system.

These urgent alarms communicate with the control module and make the LCD flash when displaying PBN STATUS.

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5 Software Description - Operation

5.1 EDFAM and OCM Program Structure

The module's software is fully automatic and constantly monitors parameters as outlined in **Section 5.5**.

5.1.1 Current Software

The EDFAM will only be recognised by an OCM with software version V3.0 and higher or by OCMR.

5.1.2 Parameter Data Explanation

The bottom line of the OCMR LCD display shows data about the module when that module is selected. The 16-character LCD line is typically made up of three components.

Name **Data and Unit** **Status**

Status Character Definitions

"N" Non-Urgent Alarm
"O" Normal Operation
"U" Urgent Alarm
"Z" Null Status

5.1.3 EEPROM Settings

The software uses EEPROM for memory back up of the lower and upper alarm limits for analogue parameters and for control variables as set by the user.

These settings will be saved into EEPROM so that the user will not need to reset these in case of a power failure.

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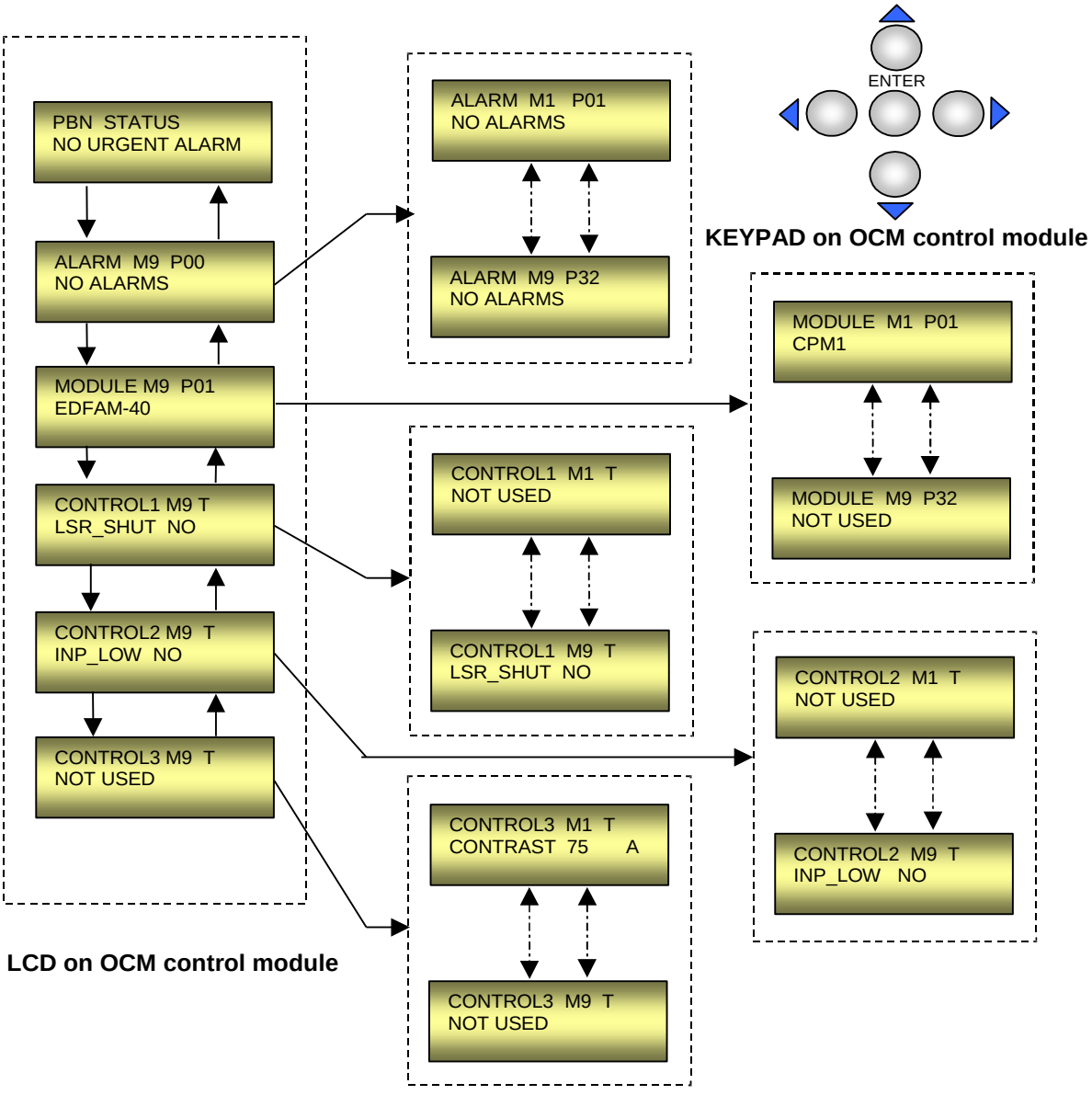
5.2 EDFAM and the OCM Program Structure

The basic control functions are similar to all plug-in modules, but each module has its own specific parameters and menu item control functions. The following is specific to the EDFAM.

> **Note:**
>
> Menu item CONTROL2 displays parameter 20, i.e. “INP_LOW NO”. This is not used as a variable in the current version of firmware and cannot be changed as a control item.

The example below includes CPM1 in slots 0 and 1 and EDFAM-40 in slot 9.



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5.3 OCMC/OCMR/CPM Keypad Lock for Control Variable Access

OCM software version 4.0 and above has a keypad lock and unlock feature for accessing the control variables. This is so that only the trained technician has the ability to change any of the CONTROL variables, restricts an unauthorised person from modifying the control variables, and prevents tampering.

The OCM user interface will require the keypad unlock sequence to be input by the user if they intend to access any of the CONTROL variables for any given module. This includes the LCD's CONTRAST level. With the keypad locked, the user has access to the following menu items only: PBN STATUS, ALARMS and MODULES. When the keypad is unlocked, access to CONTROL1, CONTROL2 and CONTROL3 becomes available.

5.3.1 Unlock access to CONTROL variables

1. Ensure that the display is at the home screen with PBN STATUS displayed. If you are not sure of your location in the menu, press **ENTER** twice to go to the home screen.
2. Press the **right** arrow key four times.
3. Press **ENTER** once.

You now have full access to the CONTROL menu items.

The interface is in its unlocked condition. The user has access to six menu items. They are: PBN STATUS, ALARMS, MODULES, CONTROL1, CONTROL2 and CONTROL3.

5.3.2 Lock access to CONTROL variables

There are three ways to lock access to CONTROL variables:

- Resetting the power
- Automatic time-out
- Manual operation

By resetting the power, the interface will start up in the locked condition by default.

Automatic time-out happens when there has been no activity (key pressing) for 15 minutes. This will also bring the display back to the PBN STATUS menu.

Manual Operation

1. Ensure that the display is at the home screen with PBN STATUS displayed. If you are not sure of your location in the menu, press **ENTER** twice to go to the home screen.
2. Press the **left** arrow key once.
3. Press **ENTER** once.

You have now locked access to the CONTROL menu items.

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5.4 Programming Sequence for EDFAM

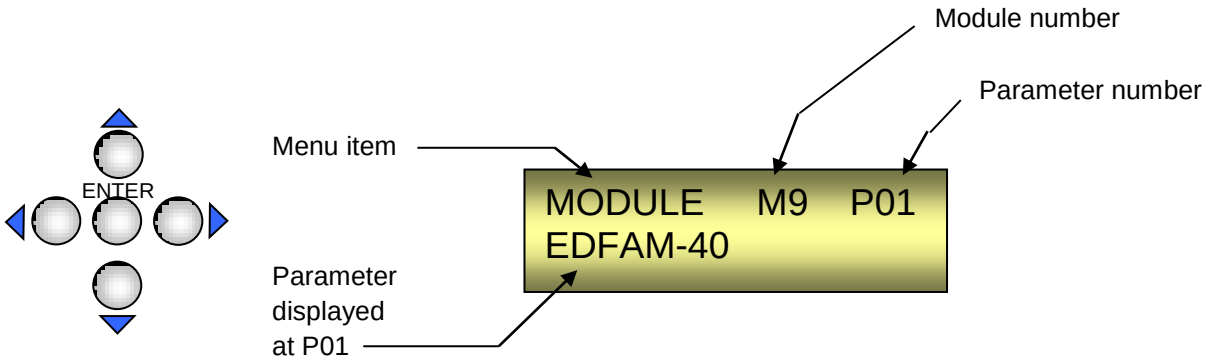
Refer to **Section 5.3** of this manual for instructions on how to enable access to the CONTROL levels.

- Select EDFAM Module
- Select CONTROL1, pump laser shut down.

The user has the ability to perform the following functions on the EDFAM optical amplifier module via the CPM module.

5.4.1 Select the EDFAM module and view its operating parameters

For a full list and explanation of the parameters used in the module refer to **Section 5.5** - Parameter List and Alarm Limits.



- Scroll down to menu item **MODULE** using the ▼ key.
- Place the cursor at **MX** using the ▶ key, where **X** represents the slot number on the chassis, into which the module is inserted.
- Select the module number you want using the ▼ or ▲ keys, e.g. if EDFAM is in slot 9, select **M9**.
- Move the cursor to **PXX** using the ▶ key, where **XX** represents a parameter from 01 to 32.
- Press the ▼ or ▲ keys to scroll through the parameter list and values.

Note:

The OCMR has four lines of text on its LCD; therefore more information may be displayed than shown in the image above. For more information please refer to the OCMR manual.

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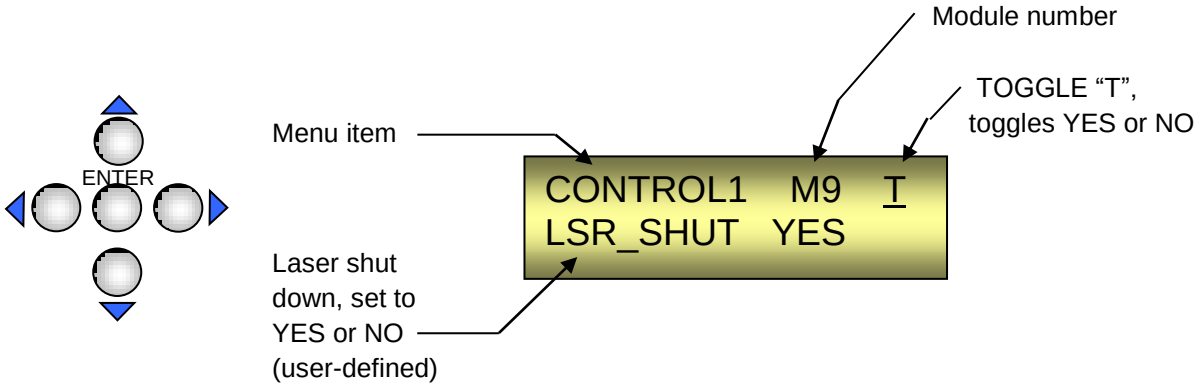
5.4.2 Pump laser shut down

The EDFAM will be in its default mode of **LSR_SHUT YES** when first powered up. This means that the EDFAM is non-operational. To activate the pump laser, hence switching on the output of the EDFAM, follow the steps below:



- Scroll down to menu item **CONTROL1** using the ▼ key.
- Place the cursor at **T** using the ▶ key.
- Press the ▼ or ▲ key to toggle between **YES** and **NO**.
- **LSR_SHUT** will change accordingly.
- Switch to **YES** to shut down the laser.
- Switch to **NO** to turn on the laser.

Note:

An urgent alarm will be transmitted through the system when **LSR_SHUT** has been activated. This is to inform the operator that there has been a major part of the network left without optical power.

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5.5 EDFAM - Parameter List and Alarm Limits

Parameter	Display (examples only)			Description
01	EDFAM-40-1-SC			Model Number of unit
02	S/N 0003001			Serial Number of unit
03	S02262	V5.10		Firmware version installed in unit
04	A02469_0			PBN's part number of Module
05	SLOT_NUM	9		Slot number of unit inside chassis. Set by bus plane of OCMR
06	MOD_TEMP	25C	O	Temperature inside module, O= OK ⇒ (0 – 69 °C) or U = urgent alarm ⇒ (≥ 70 °C)
07	OPT_IN	6.0dBm	O	Optical input power in dBm O = level is OK, (≥ -5 dBm) U = urgent alarm ⇒ (< -5 dBm) Display = "LOW"
08	OPT_OUT	16dBm	O	Optical output power in dBm O = level is OK, (as rated) LOW = level is low, (< 3 dB from rated power)
09	PUMP1	0.10A	O	Pump 1 laser current in A
10	PUMP2	0.08A	O	Pump 2 laser current in A
11	COOLER1	0.05A	O	Cooler current 1 in A
12	COOLER2 (1)	0.08A	O	Cooler current 2 in A
13	LASER1	0.15W	O	Pump laser power 1
14	LASER2 (1)	0.23W	O	Pump laser power 2
15	ALM_R	OFF		Summary Alarm RED LED, OFF = there is no urgent alarm, ON = there is an urgent alarm
16	ALM_G	ON		Summary Alarm GREEN LED, OFF = there is an urgent alarm, ON = no urgent alarm
17	EDFA_ALM	OK		This indicates the alarm status from the EDFAM unit, OK = no alarm ALM = alarm
18	LSR_SHUT (2)	NO	Z	Laser shut down state NO = shut down not activated YES = shut down activated
19	LSR_SHUT (3)	NO	Z	Laser shut down state NO = shut down not activated YES = shut down activated
20	=>OUT_MIN	0	O	Control 2 User defined input alarm threshold

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Parameter	Display (examples only)			Description
21	OUT_LOW	NO	Z	Output power low indicator NO = output power is OK, YES = output power is too low, < 3 dB from rated power
22	PUMP_ALM	NO	Z	Pump laser alarm NO = pump lasers are OK, YES = pump lasers have failed
23	OUT_MIN	10dBm	O	Control 3 Output lower alarm threshold
24	INP_LOW	NO	Z	Optical input lower alarm
25	PUMP_BIAS	OK	Z	Pump bias alarm
26	TEMP_ALM	OK	Z	EDFAM temperature alarm
27	+26V	26.0Vdc	Z	+26V rail voltage
28	+5V	5.0Vdc	Z	+5V rail voltage
29	OUT_MIN	10dBm	Z	Optical output MIN level
30	PUMP3 (4)	0.29A	O	Pump 3 laser current in A
31	PUMP4 (4)	0.29A	O	Pump 4 laser current in A
32	NOT USED		Z	This parameter is not used.

Note:

The above values displayed are for monitoring purpose and may vary in accuracy up to 10%.

Status Character Definitions

"N" Non Urgent Alarm

"O" Normal Operation

"U" Urgent Alarm

"Z" Don't Care

(1) Parameters 12 and 14 are only available for 250 mW versions and below. Other models will display "NOT USED".

(2) Parameter 18 is read only by Control 1.

(3) Parameter 19 is write only by Control 1.

(4) Parameters 30 and 31 are only available on 960 mW versions and above. Other models will display "NOT USED".

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6 Specifications

Optical Performance

Operating wavelength:	1530 nm to 1565 nm
Output power	
EDFAM-20-[Y]-[Z]:	20 mW (13 dBm)*
EDFAM-40-[Y]-[Z]:	40 mW (16 dBm)*
EDFAM-50-[Y]-[Z]:	50 mW (17 dBm)*
EDFAM-80-[Y]-[Z]:	80 mW (19 dBm)*
EDFAM-100-[Y]-[Z]:	100 mW (20 dBm)*
EDFAM-160-[Y]-[Z]:	160 mW (22 dBm)*
EDFAM-200-[Y]-[Z]:	200 mW (23 dBm)*
EDFAM-250-[Y]-[Z]:	250 mW (24 dBm)*
Input power:	0 dBm to 6 dBm**
Noise figure:	< 5.0 dB
Pump laser:	980 nm and/or 1480 nm
Remnant pump power:	-30 dBm
Optical return loss:	> 50 dB
Optical output level accuracy	± 0.5 dB
Polarization dependent gain:	0.3 dB
Optical connectors:	SC/APC with protective cover, E2000/APC, FC/APC

** These output powers are nominal for single output modules. Higher output modules employ an integrated optical splitter. For instance, an EDFAM-80-2-SC has two output ports with 40 mW each, totalling 80 mW. In cable television applications no more than 40 mW (16 dBm) launch level per fibre line should be planned to avoid excessive Stimulated Brillouin Scattering (SBS) in the connected fibres. Back-scatter can significantly reduce CNR and CSO performance. Hence the models with 80, 100, 160, 200 and 250 mW power should be ordered with an appropriate split, keeping the power per port to a more manageable level.*

*** Optimum input power for all models is 3 dBm. Absolute input power range for most models is -6 dBm to 10 dBm with possible reduction in performance.*

General

Power:	Powered by OCMR
Operating temperature:	0 °C to 45 °C
Dimensions (H x W x D:	160 x 44 x 360 mm
Ship size (H x W x D):	280 x 70 x 570 mm
Weight:	1.5 kg
Ship weight:	2 kg
Network management:	NMS3 via OCM system

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7 Product Warranty

Pacific Broadband Networks warrants its equipment to be free of manufacturing defects in material and workmanship for a period of one year from date of shipment, provided it is installed and operated in accordance with factory recommendations.

The liability of Pacific Broadband Networks under this warranty is solely limited to repairing; replacing or issuing credit provided that:

1. The warranty registration has been completed and received by Pacific Broadband Networks.
2. Pacific Broadband Networks' helpdesk is promptly notified in writing or by telephone that a failure or defect has occurred.
3. A return authorisation number is obtained from Pacific Broadband Networks' helpdesk and clearly marked on the outside of the shipping container and all documents.
4. Customer is responsible for all shipping and handling charges. C.O.D. and freight collect will not be accepted without prior approval from Pacific Broadband Networks' helpdesk.
5. The equipment (in PBN's sole discretion) has not been abused, misused or operated under conditions outside manufacturer's specifications.

The warranty does not cover the following:

1. Products purchased from someone other than an authorised Pacific Broadband Networks dealer.
2. Damage caused by accident, negligence, misuse, abuse, improper operation or failure to operate the equipment within the manufacturer's specifications.
3. Damage caused by fluctuation in electrical current, lightning, power surges, etc.
4. Damage resulting from overhaul, repair or attempt to repair caused by someone other than Pacific Broadband Networks' qualified service personnel.
5. Any product, in which the serial number has been defaced, modified or removed.
6. Any product that has been opened or modified without prior written permission from PBN.
7. Replacement of parts necessitated by normal wear and tear.
8. Any consequential or implied damages.
9. Pacific Broadband Networks will not be liable for DFB Laser failure after 90 days from receipt of item. Any claim for DFB Lasers will be presented to the laser vendor for replacement. Pacific Broadband Networks will make every effort to replace faulty lasers although ultimate judgement is at the laser vendor's discretion. Pacific Broadband Networks will provide all labour costs associated with the replacement of the laser within the one-year warranty period.

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8 Declaration of Conformity

According to ISO/IEC Guide 22 and EN45014

Manufacturer's Name:	Pacific Broadband Networks
Manufacturer's Address:	8-10 Keith Campbell Court, Scoresby, Victoria 3179, Australia
Declares, that the product Product Name:	EDFAM – Erbium Doped Fibre Amplifier Module

Conforms to the following standards:

Safety:	EN 80083-1, EN 60950, IEC 950, AS/NZS 3260:1993, EN-60825-1, IEC 825-1, AS/NZS 2211.1 Laser Safety
EMC:	EN 50083-2, EN-55022:1994, IEC/CISPR 22:1993, AS/NZS CISPR 22:2006
CATV/HFC:	EN-50083

Supplementary Information:

CE

This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

The product herewith complies with the requirements of the following directives and carries the CE-marking accordingly:

- The EMC Directive 89/336/EEC
- The Low Voltage Directive 73/23/EEC

The product was tested in a typical configuration with Pacific Broadband Networks.

FCC WARNING

This equipment has been tested and found to comply with the limits for class A device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation. This equipment generates, uses and can radiate radio frequency and, if not installed in and used in accordance with the instructions, may cause harmful interference to radio communication. Operation of this equipment in a residential area is likely to cause harmful interference, in which case, the user will be required to correct the interference at the user's own expense.

For Compliance Information ONLY, contact:

Australia:	Pacific Broadband Networks 8-10 Keith Campbell Court, Scoresby, Victoria 3179, Australia Phone:+61-3-9780-5100, Fax +61-3-9763-5522 Email: sales@pbn.com.au
Europe:	Pacific Broadband Networks Phone: +31-36-536-8011, Fax: +31-36-536-4367 Email: sales@pbneurope.eu
China:	Pacific Broadband Networks Phone: +86-10-5791-0655, Fax: +86-10-5791-0855 Email: office@pbn.com.cn
Americas:	Pacific Broadband Networks Americas LLC Phone: +1-703-579-6777 x 567, Fax: +1-703-935-4506 Email: sales@pbnamericas.com

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Offices:

China, Beijing : tel. +86-10-5791-0655
Americas, Florida : tel. +1-703-579-6777
AsiaPac, Melbourne : tel. +61-3-9780-5100
Australia, Melbourne : tel. +61-3-9780-5100
EMEA, Netherlands : tel. +31-36-536-8011

info@pbnglobal.com

www.pbnglobal.com

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